

PLUG-CONNECTION VERIFICATION FOR DETECTING A PROPERLY MADE  
ELECTRICAL PLUG CONNECTION

FIELD OF THE INVENTION

The present invention relates to a plug-connection  
verification for detecting a properly made electrical plug  
5 connection between a plug having a locking element and a  
socket.

BACKGROUND INFORMATION

10 Plug connections which are composed of a plug and a socket  
as well as a locking element securing the plug connection,  
are available in many designs. Such plug connections are  
used, in particular, in the automotive industry. These plug  
connections are plugged together by operators during the  
15 assembly process on the assembly line. Generally, no  
provision is made to verify whether the plug connection has  
been properly made.

There are different ways to verify whether such plug  
20 connections have actually been plugged together properly and  
completely. Conventionally, a plug connection is designed  
in such a manner that, by visual inspection, for example  
through a cover element, it is possible to see whether or  
not the electrical plug connection has been properly made.

25 In the automotive industry, for example, plug connections  
generally have to be made at locations that are very  
difficult to see. This involves the disadvantage that  
conventional visual inspections cannot be used here, because  
30 the operator must make the plug connection "blindly" and

therefore has no possibility to carry out a visual inspection.

It is only upon the completion of all electrical plug connections that the defect is possibly detected. However, due to the multitude of plug connections, the faulty connections can no longer be detected or only with greater effort.

An object of the present invention is to provide a plug-connection verification which allows a connection that has already been plugged together to be checked for correctness without the plug connection being accessible to view.

#### SUMMARY

In accordance with the present invention, a plug-connection verification is provided in such a manner that the state of the plug connection is transmitted to a stationary or mobile receiver element by data transmission so that the operator has the possibility of verifying the plug connection with the aid of this receiver element.

In an embodiment, a detection device is provided which includes, an analyzer unit and a data transmission unit, the analyzer unit being designed to detect the position of the locking element and the data transmission unit being designed to transmit the detected position of the locking element.

The present invention is suitable as a verification system, in particular, for monitoring plug connections in the case of plug connections in automobiles during vehicle assembly. Every plug-connector housing, independently of whether it

has a large or a small number of pins, can be proposed for use for the device according to the present invention.

It is also possible to retrofit conventional plug  
5 connections with the device according to the present invention so that there is no need to redesign plugs and sockets that already have a very complex design.

Advantageously, the plug-connection verification system,  
10 which include, the detection device, is arranged on a microchip which, for example, is adhesively bonded to the plug-connector housing or fixed in a recess provided in the plug-connector housing.

15 An analyzer unit carries out the analysis of whether or not a plug connection has been properly made.

This analyzer unit has the task of determining the position of the locking element, namely with respect to the position  
20 assumed by the locking element before it is slipped onto the socket. As the locking element is slipped on, its free end lifts, releasing, for example, a contact element which forms part of the analyzer unit. This signal, in turn, is passed on to a data transmission device and indicates that the plug  
25 connection has been properly made.

An alternative embodiment is to optically scan the position of the locking element. Further detection of the position of the locking element can be accomplished using conventional  
30 means.

Preferably, the data transmission device transmits the signal to a receiver unit. The receiver unit is arranged externally, that is, outside the reach of the plug  
35 connection. This receiver unit can emit a signal from which

the operator can infer whether or not the plug connection has been properly made.

As an advantageous further development, provision is made for the receiver unit to be arranged on the wrist of the operator (in a manner comparable to a watch). Due to this arrangement, the operator is informed whether or not the plug connection has been properly made immediately during the plugging operation. In case he or she misses a signal, this receiver unit preferably stores the corresponding coordinates of the plug and forwards this error message to a central unit so that, during intermediate or final inspection, it is possible without a great deal of effort to determine which plug connection has not been properly made.

Advantageously, it is also possible to create a certification record recording the quality of the plug connections made.

#### BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 shows a schematic representation of a plug-connector verification in accordance with the present invention, during a work process.

Figure 2A shows a schematic representation of an embodiment of a plug-connector verification for a plug having a locking element in a non-plugged position.

Figure 2B shows a schematic representation of an embodiment of a plug-connector verification for a plug having a locking element in a plugged position.

Figure 3 shows an alternative embodiment of the plug connector verification depicted in Figure 2A in a

non-plugged position.

#### DETAILED DESCRIPTION OF EXAMPLE EMBODIMENTS

5 Figure 1 shows a plug connection verification 1 for  
detecting a properly made electrical plug connection 2.  
Electrical plug connection 2 is composed of a socket 3 and a  
plug 4. Arranged on plug 4 is a locking element 5 which,  
when in the locked position, grips behind a nose 6 arranged  
10 on the side of socket 3, thus ensuring a vibration-proof  
plug connection.

When the plug connection is in the plugged state, then  
analyzer device 7 detects the state of plug connection 1  
15 and triggers a signal which is transmitted to a data  
transmission device 8.

In the example embodiment shown here, the data transmission  
device preferably sends the acknowledgment of the properly  
20 executed plugging operation to a further receiver element 9,  
along with an identification of the plug connection. This  
receiver element 9 is preferably arranged on a wrist 10 of  
the employee. Based on the state indicated on receiver  
element 9, the operator can see the quality of the plug  
25 connection immediately upon completion of the plugging  
operation. In case he or she is not able to recognize or  
interpret the signal, then this acknowledgment is forwarded  
11 to a central control unit 12 along with the  
identification of the plug connection. This central control  
30 unit 12, in turn, manages the corresponding plug connections  
and outputs the error messages at arbitrary points of the  
work process to make a correction.

Figures 2A and 2B show the principle of an analysis of the  
35 plug connection. Figure 2A shows the plug connection while

in the incomplete state. In this position, locking element 5 operates a switch 13 which is designed as part of analyzer unit 7. By moving the plug in the direction of arrow 14, the locking element opens and releases switch 13 as shown in Figure 2B. Subsequently, the signaling process already described in Figure 1 takes place to transmit the corresponding signal to the operator.

Figure 3 depicts an alternative embodiment. The analyzer unit 7' shown here includes a light-emitting diode 15, which is covered in the non-locked state. As soon as the plug connection is made, an opening 16 is cleared and a photovoltaic cell 17 (not specifically shown in Figure 3) is exposed to light. This photovoltaic cell 17, in turn, emits a corresponding signal to data transmission device 8, thus indicating that the electrical plug connection has been completed.